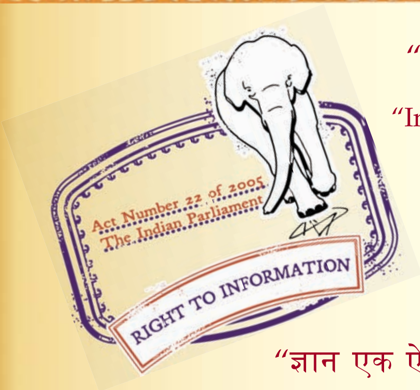
IS 11260-2 (1985): Stabilized power supplies ac output, Part 2: Tests [ETD 31: Power Electronics]



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IS : 11260 (Part 2) - 1985

(Reaffirmed 2001)

Indian Standard

SPECIFICATION FOR STABILIZED POWER SUPPLIES, AC OUTPUT

PART 2 TESTS

UDC 621·311·6·025 : 620·1

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6

December 1985

Indian Standard

SPECIFICATION FOR STABILIZED POWER SUPPLIES, AC OUTPUT

PART 2 TESTS

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Indian Standard

SPECIFICATION FOR STABILIZED POWER SUPPLIES, AC OUTPUT

PART 2 TESTS

0. FOREWORD

0.1 This Indian Standard (Part 2) was adopted by the Indian Standards Institution on 21 March 1985, after the draft finalized by the Power Electronics Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The standard on stabilized power supplies, ac output has been prepared in two parts as follows:

Part 1 Rating and performance

Part 2 Tests

These two parts are to be read in conjunction with each other.

0.3 This standard (Part 2) specifies procedures by which certain performance characteristics associated with voltage stabilized or current stabilized power supplies may be measured. The methods outlined are not only the way of conducting each measurement, but represent a reliable means of obtaining data against which other test procedures may be judged.

0.4 The requirements for stabilized power supplies, dc output are covered separately in the following Indian Standards:

IS : 7204 (Part 1)-1974 Stabilized power supplies dc output: Part 1 Terms and definitions

IS : 7204 (Part 2)-1974 Stabilized power supplies dc output: Part 2 Rating and performance

IS : 7204 (Part 3)-1974 Stabilized power supplies dc output: Part 3 Radio frequency interference tests

IS : 7204 (Part 4)-1974 Stabilized power supplies dc output: Part 4 Tests other than radio frequency interference

0.5 In preparing this standard considerable assistance has been derived from IEC Publication 686 'Stabilized power supplies, ac output', issued by the International Electrotechnical Commission.

1. SCOPE

1.1 This standard (Part 2) covers the details of measuring equipment, test conditions and procedures for determination of performance characteristics of stabilized power supplies ac output.

2. SOURCES

2.1 General — The power source shall deliver an adjustable voltage, and, if necessary, also be variable in frequency. A limiting value of internal impedance shall not be exceeded for dynamic measurements. This also applies to the measurement of the inrush current. The inrush current and the source current due to the short circuit test shall not cause an instantaneous voltage drop of greater than 10 percent to occur.

2.1.1 Voltage drops of short duration caused by capacitors at the input are normally not taken into consideration.

2.1.2 When determining output effects, the internal impedance of the source should be selected so small that during measurements of individual output effects (for example, load changes) the influence of the input voltage change is maintained so small that it only amounts to less than 10 percent of the individual output effect.

NOTE — Special source characteristics which may cause instability of the combined system should be identified.

2.2 AC Source Voltage — The harmonic content of the ac source voltage shall not exceed the value specified in **3** of IS : 11260 (Part 1)-1985*.

2.3 DC Source Voltage — The relative ac components (periodic and random deviation) of the dc source voltage shall not exceed the value indicated in **3** of IS : 11260 (Part 1)-1985*. A battery may be used for the measurement of the reactive effect of the power supply equipment on the power source.

3. MEASURING EQUIPMENT REQUIREMENTS

3.1 Measuring Equipment for Influence Quantities — The equipment for measuring influence quantities should have such a small measurement error that, when taken together with the influence quantity ranges, given in Tables 1 and 2 of IS : 11260 (Part 1)-1985*, these are maintained.

3.2 Measuring Equipment for Value of Stabilized Output Quantity — Equipment for measuring stabilized output quantities shall have error limits which are less than 10 percent of the spread of the tolerance range. When a power supply has a permissible tolerance

*Specification for stabilized power supplies, ac output: Part 1 Rating and performance.

range of $\pm e$ percent and the supplier uses a measuring instrument to test it with an error limit of $\pm n$ percent, referred to the full scale reading, then the deviation of the equipment on test should remain within the limits:

$$\pm \left(e - n. \frac{\text{full scale reading}}{\text{measured value}} \right) \text{percent}$$

where it is assumed that

$$e > n. \frac{\text{full scale reading}}{\text{measured value}}$$

3.2.1 When a user tests the same power supply with e measuring instrument which has an error limit of $\pm m$ percent, referred to the full scale reading, he is not permitted to reject it when the deviation exceeds the limit of $\pm e$ percent, but remains within the following limits:

$$\pm \left(e + m. \frac{\text{full scale reading}}{\text{measured value}} \right) \text{percent.}$$

3.3 Measuring Equipment for the Output Effect of the Stabilized Output Quantity — Apart from the measurement of the absolute value, use can be made, for instance, of a differential measuring procedure to determine the change of the output quantity. In this connection, it shall be possible to determine the change of the output quantity with an error of less than 10 percent of the output effect band.

3.4 Measuring Equipment for Other Performance Ratings — The measuring equipment shall have an error limit of less than 10 percent of the measured effect.

3.5 Internal Consumption — The internal consumption of the measuring equipment shall not significantly affect the values to be measured. If necessary, the internal consumption shall be taken into consideration.

3.5.1 Should a load current range from zero to nominal current be specified for a power supply, the measuring equipment shall require less than 1 percent of the nominal value of load current.

3.6 Time Behaviour — The attenuation characteristics (frequency response) of the measuring equipment shall be such that the specification contained in the data sheet for dynamic variations is accurately measured (upper and lower cut-off frequency).

4. MEASUREMENTS AND MEASUREMENT PROCEDURES (TESTS OTHER THAN RFI)

4.1 Conditions

4.1.1 *General* — During the measurements, the reference conditions quoted in the data sheet according to **3** of IS : 11260 (Part 1)-1985*, the rated conditions or limit conditions of operation under which the operating characteristics apply, are to be observed.

4.1.1.1 The specific examples apply to power supplies with stabilized output voltage. In the case of power supplies with stabilized output current, the data apply analogously.

4.1.1.2 In the Tables 1 to 8, a larger number of measuring points are proposed to obtain the characteristics for the data sheet. In general, it will be sufficient to use a selection of these points. The points characterized with '0' are qualified especially for type tests, those characterized with '+' are suitable for routine tests. The application of these measuring points may be subject to provisions of other Indian Standards.

TABLE 1 TEST POINTS TO OBTAIN VALUES OF THE STABILIZED OUTPUT QUANTITY

(*Clauses* 4.1.1.2 *and* 4.2.1)

Loading	Source, Voltage		
	Minimum	Nominal Value	Maximum
Minimum	0	+	0
Mean	0		0
Maximum	0	+	0

TABLE 2 TEST POINTS TO OBTAIN VALUES OF THE STABILIZED OUTPUT QUANTITY

(*Clauses* 4.1.1.2 *and* 4.2.3)

Output Quantity	Loading	Source Voltage		
		Minimum	Nominal Value	Maximum
Minimum	Minimum	0	+	0
	Maximum	0	+	0
Maximum	Minimum	0	+	0
	Maximum	0	+	0

*Specification for stabilized power supplies, ac output: Part 1 Rating and performance.

TABLE 3 TEST VALUES TO OBTAIN DYNAMIC OUTPUT QUANTITIES

(*Clauses* 4.1.1.2 *and* 4.12)

Set value of the stabilized output quantity = ...

Source Voltage	Load Step Referred to the Nominal Load	Maximum Overshoot/ Undershoot Amplitude	Recovery Time
Minimum	{ 80 percent → 100 percent 30 percent → 50 percent	0	0
Nominal value	{ 80 percent → 100 percent 100 percent → 80 percent	+	+
Maximum	{ 100 percent → 80 percent 50 percent → 30 percent	0	0

TABLE 4 TEST VALUES TO OBTAIN DYNAMIC OUTPUT QUANTITIES

(*Clauses* 4.1.1.2 *and* 4.13)

Set value of the stabilized output quantity = ...

Loading	Input Voltage Steps Referred to the Nominal Voltage	Maximum Overshoot/ Undershoot Amplitude	Recovery Time
Minimum	100 percent → 105 percent	0	0
Mean	{ 100 percent → 105 percent 100 percent → 95 percent	+	+
Maximum	100 percent → 95 percent	0	0

TABLE 5 MAXIMUM OVERSHOOT AMPLITUDE

(*Clauses* 4.1.1.2 *and* 4.18)

Set value of the stabilized output quantity = Reference value

At Nominal Input Voltage = ...	Loading	Maximum Overshoot Amplitude
Switching on	Reference value	0
Switching off	Reference value	0

TABLE 6 TEST POINTS TO OBTAIN CURRENT LIMITING

(*Clauses* 4.1.1.2 *and* 5.2.2)

Set value of the stabilized output quantity = ...

Source Voltage	Maximum Limited Current	Voltage at Maximum Limited Current	Short-Circuit Current
Minimum	0	0	0
Nominal value	+	+	+
Maximum	0	0	0

TABLE 7 TEST POINTS TO OBTAIN OUTPUT QUANTITIES

(*Clauses* 4.1.1.2 *and* 5.3)

Set value of the stabilized output quantity = ...

Source Voltage	Loading	Input Current	Efficiency	Power Factor	Harmonic Content of the Input Current
Minimum	Minimum				0
	Maximum				0
Nominal value	Nominal value	0	0	0	
Maximum	Minimum				0
	Maximum				0

TABLE 8 CONDUCTED INTERFERENCE ON THE POWER SOURCE

(*Clauses* 4.1.1.2 *and* 5.4.3.7)

Set value of the stabilized output quantity = ...

Source Voltage	Loading	Superimposed Alternating Voltage $U\sim$ on the Input Voltage (Direct Measurement)	Superimposed Alternating Current $I\sim$ on the Input Current (Indirect Measurement)
Minimum	Nominal value	0	0
Nominal	Nominal value	+	+
Maximum	Nominal value	0	0

4.1.1.3 If the size of the power supply or the load characteristics make it impractical to achieve the maximum loading test point, tests may be made at other load conditions, by calculation or by other test procedures as agreed upon between the user and the manufacturer.

4.1.1.4 Loading as noted in the Tables 1 to 8 shall include specified power factor (range) as well as other load conditions.

4.1.2 *Commencement of Measurements of the Static Input and Output Values*

4.1.2.1 Measurements shall take place only after completion of the specified warm-up time. If no warm-up time is specified, the power supply and measuring equipment should be operated for half an hour under the reference conditions, if this is possible without damage of the power supply.

4.1.2.2 Measurements shall be made at the earliest after attainment of a steady state, that is, as a rule 5 t_G to 5 t_G + 10 s after the setting of an influence quantity (t_G = recovery time).

4.1.2.3 Should the measurements not be carried out immediately after the attainment of a steady state, the additional variation due to the setting effect, and low frequency modulation shall be taken into consideration.

4.1.3 *Changeover Time for the Measurement of Dynamic Output Effects* — The switching time for load, input voltage and control steps shall be less than 0·1 t_G. The changeover shall occur continuously without overshoot or bounce.

4.1.4 *Stabilized Output Quantity* — If the power supply offers a selection of output settings, carry out the load effect measurement at maximum rated value and repeat with the stabilized output quantity set to minimum rated value. If the minimum value is zero, conduct the measurement at 1 percent of maximum value.

4.1.5 *AC Voltage (Current) Distortion* — Periodic and random deviations of the stabilized output quantity shall be measured in the frequency range specified in the data sheet. Periodic deviations below the lower limit frequency shall be recorded as modulation.

4.1.6 *Output Effects* — The output effects shall be measured within the influence quantity bands specified in the data sheet [*see* Table 1 of IS : 11260 (Part 1)-1985*]. Should individual output effects be measured, then the other, influence quantity shall be kept so stable that their effect remains below 10 percent of the individual output effect to be measured.

4.1.7 *Ambient Temperature* — Unless otherwise agreed, the measurements are carried out at a reference value of the temperature.

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*Specification for stabilized power supplies, ac output: Part 1 Rating and performance.

4.2 Static Value of Stabilized Output Quantity

4.2.1 *Equipment Having Only One Output* — Recommended test points to obtain values of output quantity are given in Table 1.

4.2.2 *Equipment with More than One Output* — If a power supply has more than one output, when determining the output effect, all outputs should be measured simultaneously, with minimum and then with maximum loading.

4.2.3 *Equipment with Adjustable Outputs* — The recommended test points to obtain values of the output quantity are given in Table 2.

4.3 Set-Up for Measurement of Static Values — Direct measurements of voltage and current may be done according to Fig. 1 and 2.

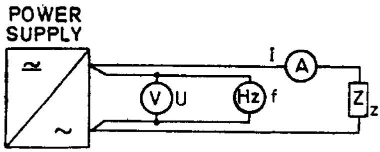


FIG. 1 SET-UP FOR AC VOLTAGE POWER SUPPLIES

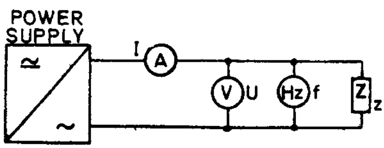


FIG. 2 SET-UP FOR AC CURRENT POWER SUPPLIES

4.3.1 *Errors* — The errors in measurement due to contact resistance and voltage drop in connecting cables shall be avoided in ac voltage power supplies if separate connections are made from the output terminals of the equipment to the loading means and to the measuring means.

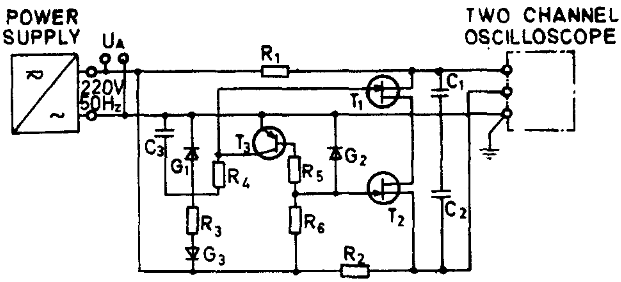
4.3.2 In the case of ac current power supplies, the measuring means shall be connected in parallel to the loading means.

4.4 Static Output Effects — The output effect for load and input voltage changes may be calculated from the measurements according to **4.1.2** as the maximum difference of the values. Measurement should be carried out by means of measuring equipment in accordance with **3.3**.

4.4.1 The output effect caused by frequency changes of the input voltage and by changes of the ambient temperature should only be measured by special agreement.

4.5 Periodic Output Voltage Modulation — The test for periodic output voltage modulation and acceptable limits shall be a matter of agreement between the user and the manufacturer.

4.6 Periodic Frequency Modulation — The test for frequency modulation and acceptable limits is subject to agreement between the user and the manufacturer.



U_A = Output voltage of the power supply to be tested

Dimensioning for U_A = 220 V, 50 Hz

$C_1 \ldots C_3$ = 2·2 μF

G_1, G_2 = Voltage reference diode 10 V

G_3 = Si diode 500 V

T_1, T_2 = Field effect transistor

T_3 = Si-PNP transistor

$R_1 \ldots R_6$ = 470 k Ω, 0·1 W

Fig. 3 Example for a Set-up to Measure Dynamic Deviations of the Mean Value

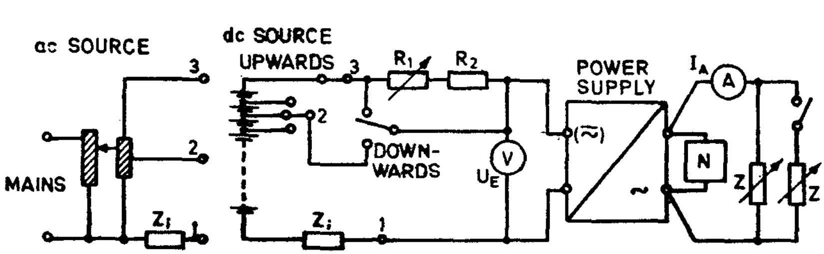


Fig. 4 Example for Set-up for Dynamic Variations

(Set-up for measuring U_A, for instance, according to Fig. 3)

4.7 Dynamic Output Effects (*see* Fig. 3 and 4) — In the case of step changes of the influence quantity, the dynamic output effects of the output values (*see* Tables 3 and 4) should be measured according to the data sheet [*see* Table 1 of IS : 11260 (Part 1)-1985*].

4.7.1 Dynamic output effects may result from the application of source voltage or the application of the load. In the case of application of an ac source or of the load, the dynamic output effects may depend on the instant the transient starts. If so, the most unfavourable value may be determined as follows:

a) A synchronous switch method wherein the transient shall be initiated at a number of predetermined phase angles with respect to the influence quantity considered; or

b) By a statistical method which employs approximately 20 switchings at random times. With this procedure, an accuracy sufficient for most applications is obtained.

4.8 Peak Value Stabilization — In the case of equipment with peak value stabilization, the dynamic output effects are determined by the course of the peak value of the output quantity.

NOTE — This may be most easily determined by observing the peak value of the double way rectified value of the output quantity.

4.8.1 According to Fig. 5, 6, 7 and 8, the dynamic output effects are determined from the course of the peak values (connection of the individual points).

4.8.2 The upper cut off frequency of the measuring equipment for the recording of these values shall be about ten times the frequency of the output quantity.

4.9 Mean Value Stabilization — In order to determine the dynamic output effects in the case of single phase equipment with mean value stabilization, the course of the amount of the mean values of each half-wave of the output quantity shall be taken into consideration.

4.9.1 According to Fig. 5, 6, 7 and 8 the dynamic output effects may be determined from the course of the mean values (connection of the individual values).

4.9.2 Figure 3 shows a set-up for the determination of dynamic deviations of the mean value. A dc bias may be inserted in the output measuring equipment to improve sensitivity.

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*Specification for stabilized power supplies, ac output: Part 1 Rating and performance.

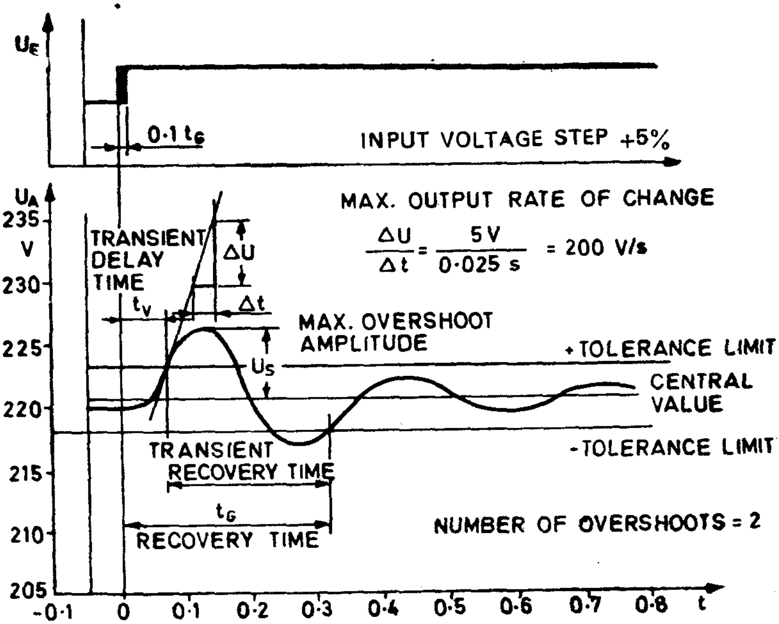


FIG. 5 EXAMPLE OF TRANSIENT PERFORMANCE OF A STABILIZED AC POWER SUPPLY WITH TOLERANCE BAND SPECIFIED

4.9.3 As far as equipment with polyphase output is concerned, it may be necessary to consider the course of the mean value of the polyphase double way rectified output voltage (operation method of the set-up according to Fig. 3).

4.9.4 The capacitors C_1 and C_2 are charged alternately from the voltage of the two half-waves over the resistors R_1 and R_2.

4.9.5 At the end of each half-wave the capacitors are charged to a voltage which is proportional to the mean value of the half-wave. During the opposite half-waves, the capacitors are alternatively short-circuited and discharged by the field effective transistors T_1 and T_2. The voltage at the capacitors should be about 1 percent of the applied ac voltage.

In the case of mean value stabilization, the course of the peak value of the output voltage may also be taken into consideration if the waveform is sufficiently sinusoidal (*see* **4.8**).

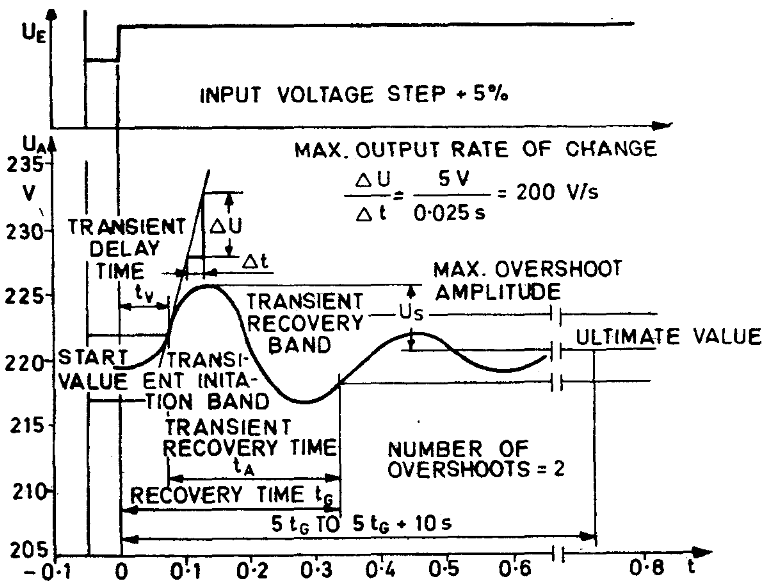


FIG. 6 EXAMPLE OF TRANSIENT PERFORMANCE OF A STABILIZED AC POWER SUPPLY WITH EFFECT BAND SPECIFIED

4.10 RMS Value Stabilization — In the case of equipment with rms value stabilization, the course of the rms values of each half-wave of the output quantity may also be used to determine the dynamic output effects.

4.10.1 In the case of rms value stabilization, the course of the mean values according to **4.9** or the course of the peak values according to **4.8** of the output voltage may also be used to determine the dynamic output effects if the waveform is sufficiently sinusoidal.

4.11 Waveform Stabilization — In the case of equipment with waveform stabilization, the difference between the instantaneous values of the output quantity and the given reference alternating quantity may be used to determine the dynamic output effect.

4.11.1 The upper cut-off frequency of the measuring equipment for the recording of these values should be about 100 times the reciprocal value of the recovery time specified in the data sheet.

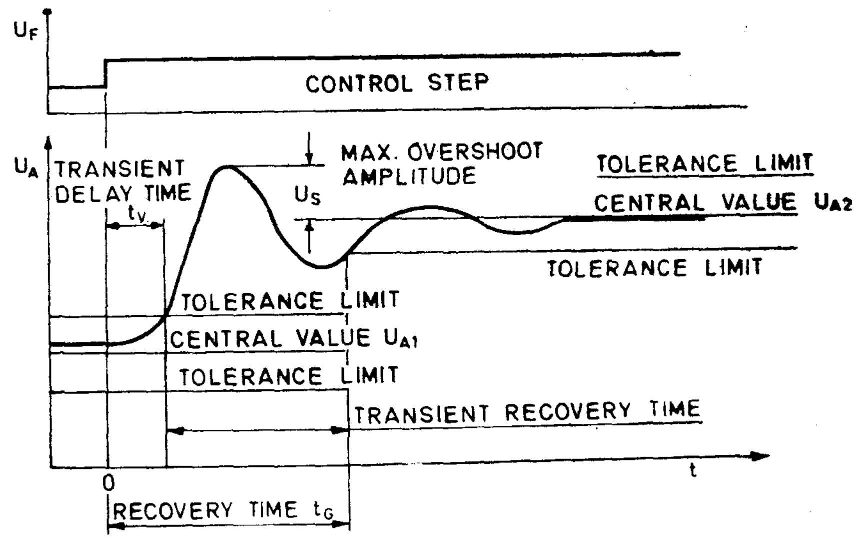


FIG. 7 EXAMPLE OF TRANSIENT PERFORMANCE OF A STABILIZED POWER SUPPLY WITH TOLERANCE BAND SPECIFIED IN THE CASE OF A STEP CONTROL CHANGE

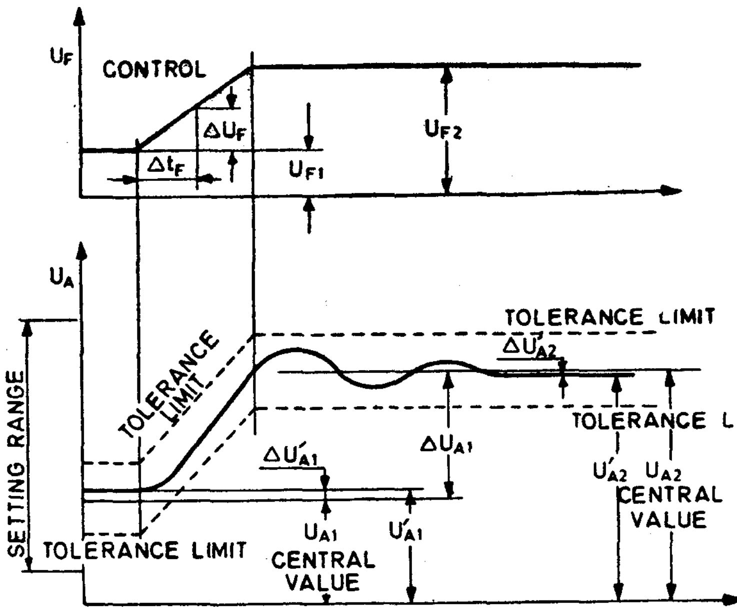
4.12 Load Steps — In the absence of a specification, the load steps shall be taken according to the conditions specified in Table 3. The important quantities to be measured are the maximum overshoot/undershoot and the recovery time.

4.13 Input Voltage Steps — In the absence of a specification, the input voltage steps are taken according to the conditions specified in Table 4. The important quantities to be measured are the maximum overshoot/ undershoot and the recovery time.

4.14 Set-up for Input Voltage and Load Steps — The set-up for measurement of input voltage and load steps is given in Fig. 4.

4.14.1 It is important, when testing the transient behaviour with input voltage steps, that after the step, only the internal impedance Z_1 of the power source is effective. If neccessary Z_1 has to be agreed upon (frequency dependent).

4.14.2 R_1 and R_2 are to be adjusted such that during the transient the voltage does not drop lower than that on point 2 in Fig. 4, if the series resistors R_1 and R_2 affect the measuring result, a circuit arrangement without series resistors should be used.



Control rate $= \dfrac{\Delta U_F}{\Delta\, t_F}$

Control coefficient $= \dfrac{U_F}{U_A}$

Control daviation $= \Delta\, U'_A = U'_A - U_A$

FIG. 8 EXAMPLE OF TRANSIENT PERFORMANCE OF A STABILIZED POWER SUPPLY WITH TOLERANCE BAND SPECIFIED AND CONTINUOUS CONTROL CHANGE

4.15 Control Change — If the output values of stabilized power supplies are switched over, remotely controlled or programme controlled, dynamic phenomena then occur which are illustrated in Fig. 7 and 8.

4.16 Step Control Change — In this case, the control is switched over from initial to final value.

4.17 Continuous Control Change — In this case, the control is changed from initial to final value at the maximum control rate.

4.18 Switch-On and Switch-Off Maximum Overshoot Amplitude — In the absence of a specification, measurements are carried out according to the conditions specified in Table 5.

5. MEASUREMENT OF OTHER OPERATING CHARACTERISTICS

5.1 Short-Circuit Current and Current Limiting Regulation Response — The short-circuit transient may be dependent on the point in the output voltage waveform at which the short-circuit is applied as well as the value of load current immediately prior to initiation of the short-circuit current.

5.1.1 In the case of equipment with specified current limiting, the short-circuit shall be applied at the output terminals after the power supply has been energized and in the steady state condition. Correct transient shall be recorded.

5.1.2 The test at maximum source voltage and nominal current shall be repeated in accordance with **5.2** as a type test. For power supplies other than those with specified current limiting, the short-circuit current test and limits shall be as agreed to by the user and the manufacturer.

5.2 Steady-State Current Limiting — In the case of equipment with specified current limiting the maximum limited current together with the relevant voltage as well as the short-circuit current shall be measured.

5.2.1 In the case of power supplies with stabilized output current, the voltage limiting is to be measured.

5.2.2 The recommended test points are given in Table 6.

5.3 Input Current, Efficiency, Power Factors, Harmonic Content of Input Current — The recommended test points are given in Table 7.

5.3.1 Efficiency is measured using the test circuit given in Fig. 9.

5.3.2 When measuring the active input and output power, a check shall be made to determine whether the internal consumption of the wattmeter used is so small that it can be disregarded. If the error is too great, the indicated value shall be corrected accordingly.

5.3.3 The active power of the direct current side can be calculated, as the product of the arithmetic average of the voltage and current, as long as the voltage and current on the direct current side have a periodic and random deviations (PARD) content of less than 5 percent. A wattmeter should be used to make the dc power measurements if this condition is not fulfilled.

5.4 Interference

5.4.1 *Radio Frequency Interference* — Radio frequency interference (RFI) shall be measured in accordance with IS : 7204 (Part 3)-1980*.

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*Specification for stabilized power supplies, dc output : Part 3 Radio frequency interference test.

5.4.2 *Conducted Interference in the Case of Power Supplies with ac Input* — The harmonic content of the current may be determined indirectly by measurement of the fundamental wave (wattmeter, ammeter and voltmeter according to Fig. 9), directly with a distortion measuring instrument or by selective measurement.

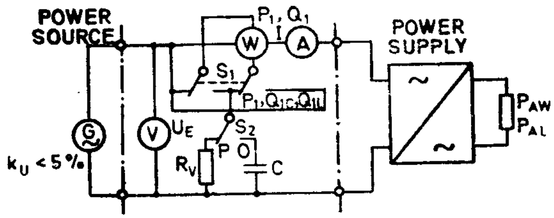

FIG. 9 EXAMPLE OF SET-UP FOR MEASURING CONDUCTED INTERFERENCE IN THE CASE OF EQUIPMENT WITH AC INPUT

NOTE 1 — A similar arrangement may be used on the output side to determine efficiency.

NOTE 2 — The reactive power is measured on changeover of S_2 (substitution of the series resistor $R_V \gg \omega L$ of the voltage path by a capacitor of which $\frac{1}{\omega C} \approx R_V$.

The meter must deflect in the correct direction when the voltage coil is reversed by S_1; according to whether Q_1 is inductive or capacitive. The harmonic content of the current k_I can be calculated from the measured fundamental wave content using the above test procedure. If the fundamental wave or the harmonics are measured selectively, or the harmonics with a distortion meter, the following equation applies:

$$k_I = \frac{\sqrt{I_2^2 + I_3^2 + \dots\dots\dots I_n^2}}{\sqrt{I_1^2 + I_2^2 + \dots\dots\dots I_n^2}} = \sqrt{\frac{I^2 - I_1^2}{I^2}}$$

5.4.3 *Conducted Interference in the Case of Power Supplies with dc Input* — The conducted interference on the power source is either measured directly (voltage measurement) or indirectly (current measurement). It is either the effective value of the superimposed alternating quantity or the effective values of their sinusoidal components which are measured.

5.4.3.1 *Direct measurement* (*voltage measurement*) — The direct measurement assumes a power source with a defined internal resistance Z_1. In this case, the test power source is also at the same time the operating power source (Fig. 10). It is the alternating voltages, generated at the terminals of the power source by the operation of the power supply, which are measured.

The values for 'superimposed ac voltage', 'ac voltage content' or 'PARD' are measured with a voltmeter or an oscilloscope.

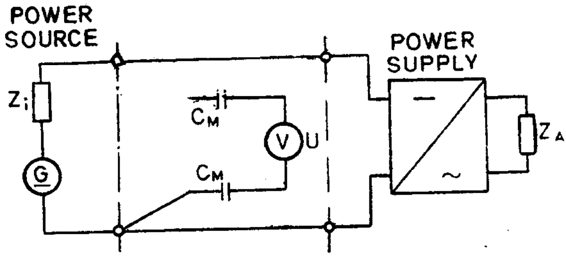

FIG. 10 EXAMPLE OF SET-UP FOR THE DIRECT MEASUREMENT OF THE CONDUCTED INTERFERENCE WITH DC INPUT

5.4.3.2 *Indirect measurement (current measurement)* — Indirect measurements of the conducted interference of a power supply on the power source is to be used if:

a) the power source with the defined internal resistance is not available, and

b) the input impedance of the power supply is considerably greater than the internal resistance Z_{iB} of the power source provided to be used in operation.

The internal resistance Z_{iP} of the test power source is then permitted to deviate considerably from Z_{iB} of the operating power source (Fig. 11).

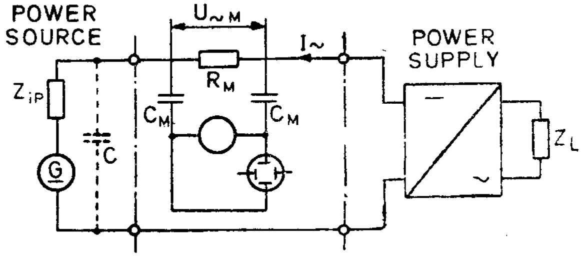

FIG. 11 EXAMPLE OF SET-UP FOR THE INDIRECT MEASUREMENT OF THE CONDUCTED INTERFERENCE WITH DC INPUT

5.4.3.3 It is the alternating current $I_{\sim}$ superimposed on the recorded direct current which is measured.

$$I_{\sim} = \frac{U_{\sim M}}{R_M}$$

5.4.3.4 The required values for 'superimposed ac current', 'ac current content' or 'ripple current' are measured with a voltmeter or an oscilloscope.

5.4.3.5 The internal impedance Z_{iP} can be altered by adding the parallel capacitors; the measurement is accurate when the resulting source impedance is small compared to the load impedance.

5.4.3.6 The conducted interference to be expected on the operating power source with Z_{iB} will then be:

$$U_{\sim B} = I_{\sim} . Z_{iB}$$

where Z_{iB} is the users' source impedance.

5.4.3.7 The recommended test points are given in Table 8.

5.5 Inrush Current — The inrush current of alternating current equipment is to be determined either by measurements with a phase angle switching instrument at intervals of approximately 15° electrically or by a statistical method which employs approximately 20 switchings at random times with a sufficient accuracy for most applications.

5.5.1 The inrush current of equipment with dc input is to be determined according to **5.4.3.**

5.5.2 The inrush current is the maximum instantaneous value disregarding the course of the current during the first millisecond.

5.6 Insulation Resistance — The insulation resistance shall be measured by means of an insulation tester at a dc voltage of not less than 100 V.

5.7 Isolation Voltage — The isolation voltage shall be measured in accordance with the regulations applicable to the equipment.

5.8 Capacitance to Frame, Capacitance to Source Terminals — The effective capacitance shall be measured by means of a capacitance bridge with the equipment switched off from the source.

5.9 Electromagnetic Compatibility (EMC) — The operating characteristics of the equipment, in particular the deviation of the stabilized output quantity and the superimposed ac voltage, shall not exceed the indicated values when a field strength, in accordance with the data sheet [*see* Table 2 of IS : 11260 (Part 1)-1985*].

5.10 Audible Noise — Audible noise test procedure and limits shall be as agreed upon between the user and the manufacturer.

*Specification for stabilized power supplies, ac output: Part 1 Rating and performance.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2